Selenium Confined in Porous Membranes

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Abstract No. Nare9425
Beamline(s): **X18A**

Introduction: Selenium posses many interesting and peculiar properties that are not entirely understood and that require further study. The bulk structure of selenium is a hexagonal structure with a small c/a ratio; while, under vaporization or high-pressure two monoclinic phases. In the two monoclinic phases (α and β), the selenium forms long chains. No study of the effects of confinement on the structure of selenium has yet been undertaken. These studies could result in insight into the physics of the selenium structures.

Methods and Materials: The effects of confinement on the structure of one-dimensional selenium wires have been studied through x-ray diffraction. In these studies the sources of confinement have been introduced through polycarbonate and alumina membranes. The polycarbonate and alumina membranes are produced such that they are porous, with the polycarbonate membrane possessing a pore size of 70nm and the alumina membrane possessing a pore size of 200nm. Both the membranes have a thickness of 10μm. Once the membranes are produced, selenium is grown in the pores through electro-deposition. Also, for reference, selenium has been deposited on a gold covered glass slide so that the bulk structure can be observed.

Results: X-ray diffraction measurements of selenium wires deposited in the membranes were made at various temperatures. In both membranes, a reversible thermodynamic phase transition is observed. The transition is from a more complex structure to a much less complex structure (Fig. 1). The transition takes place at different temperatures for the different membranes. In the polycarbonate membrane, the transition occurs at around 410K, while in the alumina membrane, the transition occurs closer to 480K.

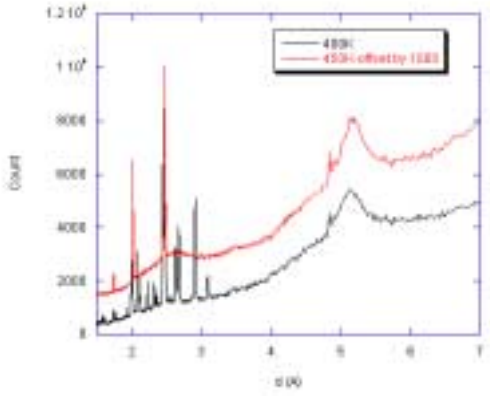

Figure 1. Selenium in a Polycarbonate Membrane